PSP Calibration Using Shade/Unshade Method (CALC)

I. Purpose:

The purpose of this procedure is to describe the steps performed by the RESET team to check the calibration of the PSP using the Shade/Unshade method. Usually this procedure is performed in conjunction with the NIP Cavity Radiometer Calibration Check.

II. Cautions and Hazards:

Electrical Hazard: Take care when climbing onto or next to the radiation stand while performing the Shade/Unshade Method. The Control Unit for the Cavity Radiometer runs on 110 Volt AC power (240 V internal). Only a RESET team member trained in electrical safety may conduct these procedures.

III. Requirements:

- Clear, stable atmosphere with minimal circumsolar radiation during data collection.
- Two people for actual mounting of the Cavity to the tracker (one to hold the instrument and the other to mount to tracker).
- Absolute Cavity Radiometer (Hickey-Friedan).
- Control Unit and two cables (two pair 14 ft and 20 ft) (Cavity and Serial Communications Cables).

  Note: fuse for Control Unit 312 2 Amp, 250 V.
- Calibration laptop (with power adapter, terminal emulator, and cavity radiometer software).
- Protective enclosure for laptop computer and cavity control unit.
- Solar tracker mounted NIP.
- Clock set to GMT time.
- 3/16" and 3/32" allen wrench.
- Small flat head screwdriver.
- Kimwipes.
- Rubbing alcohol.

IV. Procedure:

A. Start Calibration Procedure:

See reference PRO(NIP)-002.001 for more detail on Cavity Radiometer setup.

1. Set clock to within one (1) second of GMT before starting.
2. Run A/C Power to SKRAD stand to power control unit and laptop computer.
3. Put computer and control unit in protective enclosure.
4. Connect two (2) cables from control unit to laptop computer (25 pin connector control unit with a 9 pin D connector to COM1 and special PCMIA connector to COM2).
5. Remove comparison NIP if necessary.
6. If window is not on the cavity, go indoors and attach window (six (6) screws with 3/32" allen wrench).
7. Clean window with rubbing alcohol and Kim wipes.
8. Attach Cavity to Brusag Tracker and align (see Section E)(two-man job).
9. Make final alignment using sun target with three (3) alignment screws (3/16" allen wrench).
10. Connect control unit to Absolute Cavity (two (2) connectors at each end).

Note: make sure the small ground wires are attached at both ends to nearby case screws.

11. Turn on switch on control unit (see set for Control Unit below) and DMM switch (make sure Control Unit A/M Switch is on Automatic [A]).
12. Set switch on Automatic (A).
13. Power on unit.
14. Meter connection on middle pair (Input) red to high (Hi), black to low (Lo).
15. Power on meter (lower left button); it should read DC V (if not turn off and on again to reset).
16. Shutter runs automatically (light “on” means shutter closed and only will use shutter one (1)).
17. Power up computer.
18. Run Windows.
19. Run Cavity Control Program (click on icon).
20. Input Cavity information or load from file (example 30494.cav).

21. Do not select window mounted (the TWP Cavity always has a window to protect it from rain).
22. Set correct Time and Date (use GMT time to within one (1) second; this can be obtained from ADaM or MACS GPS time and setting a watch).
23. Enter Site information, e.g., manus.sit.
24. Enter Data Collection setup (click "field cal," buttons then OK). (The system now runs by itself with four (4) minutes for electronic calibration. Messages and switch setting letters change as the system runs automatically. The calibration sensitivity then is displayed, e.g., 0.01033 mV/mW/cm2; the unit then proceeds to take data.)
25. Three files will be produced (A...., C...., and D.....files)
    - A: average data (decimal time, hh:mm:ss, date, day of year, lat., long., 1.055 window const., site name, serial #, and seven (7) fields of average data; field 2 is time, 5 is irradiance W/m2, 3 is elevation, and 4 is azmuth.
    - C: calibration data (start time, end time, and ten (10) fields of calibration data; field 10 is sensitivity).
    - D: raw data (three (3) data fields for each line; time in s, raw thermopile reading, calculated irradiance).
26. Check the cavity alignment and computer status every 30 minutes.
    - If the cavity is out of alignment realign and note time.
    - If the program stops, reboot the computer (Ctrl Alt Delete). (You can tell the program has stopped by a lack of change of the values, if the mouse cursor does not move, or if the cavity irradiance values are unreasonable, e.g., 20345 W/m2. This can happen if a cloud passes during the four (4) minute calibration period; reboot and start over with step 17.)
27. Collect data until sunset or sky conditions deteriorate, e.g., sun remains behind a cloud for an extended period or rain is possible.

B. Shade/Unshade PSP:

1. Follow steps above and continue to take data with the Cavity.
2. Notify the data system and remove the PSP from the SKYRAD Datalogger and connect to the Calibration Data Logger.
3. Log “begin time” for solar zenith angle calculations.

4. Every five (5) minutes, alternately remove and then replace the shading disk on the PSP, i.e., five (5) minutes shaded and five (5) minutes unshaded. Repeat procedure for at least ten (10) pairs of readings.
5. Log “end times” for solar zenith angle calculations.

See Attachment 1 to PRO(NIP)002.002.

C. Setup for Controller:

1. Heater 1 & 2 switches off.
2. Set switch on A.
3. Power on unit.
4. Meter connection on middle pair (Input) red to high (Hi), black to low (Lo).
5. Power on meter (lower left button); it should read DC V (if not turn off and on again to reset).
6. Shutter runs automatically (light “on” means shutter closed and only will use shutter 1).

D. To Stop Taking Data:

1. Pause data collections (do not power off unless absolutely necessary, i.e., unexpected rain storm occurs).
2. Now select normal shutdown (performs another calibration and stops; usually best option), or Calibrate and Continue (recalibrate if calibration sensitivity seems strange), or Fast Shutdown (no secondary calibration performed).
3. Click on Quit.
4. Turn off meter (important: otherwise internal battery depleted).
5. Power down.

Note: Take Control Unit and computer inside first if it begins to rain. Then bring in Cavity (the Cavity has a window but do not leave out in rain).

E. Alignment of Cavity After Mounting on Brusag Tracker:

1. Loosen screws holding aluminum brackets for NIP or Cavity.
2. Remove reference NIP if necessary (two people necessary).
3. Mount Cavity and tighten bracket screws until instrument is firmly held and balanced (two people necessary).

4. Align Cavity using two (2) sets of three (3) screws at the bottom part of Cavity; solar illumination ring attached to the Cavity side flange.
5. Alternately loosen and tighten opposing sets of screws until sun dot is directly in the center of the solar illumination ring; be sure all screws are tight after alignment.

F. Packing:

1. First wrap Control Unit and Cavity in Plastic Bags.
2. Place Control Unit into bottom of Control Unit Box.
3. Put in a layer of foam on top and then cables and then a layer of foam on top.
4. Place Cavity in Cavity Box and place foam to tightly seal.

V. References:

1. Cornwall, C., "Recommended Radiometer Calibration Procedures for ARM/ARCS," NREL June 16, 1995.

VI. Attachments:

None.